

CANADIAN NUCLEAR SAFETY COMMISSION'S REGULATORY OVERSIGHT OF THE LORADO SITE CLEANUP PROJECT

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Abstract

This paper provides an overview of the Canadian Nuclear Safety Commission's (CNSC) regulatory oversight of the Lorado uranium mill site remediation project. Lorado is a historic site resulting from the former operation of a uranium mine in Northern Saskatchewan during the late 1950s. The most significant waste feature at Lorado was an unconfined tailings area which extended into a lake. Lorado is being remediated under the Government of Saskatchewan's commitment to the cleanup of abandoned uranium mine sites in northern Saskatchewan. This project is regulated under a 10-year CNSC licence issued to the Saskatchewan Research Council and entails the remediation of tailings that cover a land surface area of 14 hectares and treatment of lake water to improve water quality around the site. CNSC compliance verification activities include technical evaluations and inspections to ensure the project meets regulatory requirements and is in conformity with general safety objectives. Key aspects regarding CNSC's regulatory oversight of Lorado are highlighted including the remedial process, engineered cover design for the tailings, environmental monitoring, and the consideration of other regulators as well as community concerns.

1. Introduction

As Canada's nuclear regulator, the Canadian Nuclear Safety Commission (CNSC) is responsible for licensing and compliance of remediation activities at nuclear legacy sites. Ensuring compliance with legislation, regulations and licensing requirements is carried out through compliance verification and enforcement activities. This paper provides an overview of the CNSC licensing and compliance processes for the legacy Lorado mill remediation project. The Lorado mill site was chosen as a case study as it involves in situ remediation of uranium mine tailings in a remote location, including construction of an engineered cover using local materials. Specific examples of compliance prior to and during remediation of the site by CNSC staff are provided. This particular project also makes for an interesting case study because of the significant involvement of Aboriginal communities with the project.

2. Background

The Lorado mill was operated by Lorado Uranium Mines Ltd. from 1957 to 1960 and refined ore from the Lorado mine and satellite mines in the region. The Lorado mill was closed in 1961 and there was minimal decommissioning work completed. The Lorado mine site is several kilometres away from the Lorado mill and is not included in the Lorado mill site remediation project.

At the end of operations at Lorado, uranium mine tailings covered an area of about 14 hectares, including tailings submerged in the adjacent Nero Lake (Photo 1). Over time, the state of the abandoned mill worsened due to natural deterioration and vandalism. Furthermore, acid generation from the pyritic mine tailings decreased the pH in Nero Lake to 3.5 and concentrations of metals and radionuclides were elevated. The mill structure was dismantled in 1990 and efforts were focused on characterizing the tailings, improving knowledge of contaminant transport and environmental impacts and developing general remediation strategies. The need for a barrier between the tailings and the environment became apparent, in order to limit windblown dust, contaminant transport of metals and radionuclides into the environment and radiation exposure. Local communities helped to raise awareness, including residents of nearby Uranium City.



Figure 1 Aerial view of Lorado mill tailings site in 2015 (Photo courtesy of SRC)

The Province of Saskatchewan has managed the mill site and tailings management area since 2007. The Saskatchewan Ministry of the Economy (ECON) appointed Saskatchewan Research Council (SRC) as the project manager to oversee the ongoing management and remediation of the Lorado site. The environmental assessment review was completed in 2013 and CNSC was involved in the process as a Federal Authority. CNSC issued SRC a ten-year Waste Nuclear Substance Licence (WNSL) in 2013 which allows for the possession, management and storage of nuclear substances resulting from historic milling operation at the Lorado Site. CNSC ensured that environmental protection was accounted for through licensing of the site. Over the long-term

the remediation project will aim to transfer the Lorado site into the Saskatchewan Institutional Control Program.

2.1 Remediation of mine tailings

Remediation of the mine tailings consists of in situ management by placing an engineered cover on the tailings. The cover consists of a 1 m layer of sand, which serves as a capillary break, and 0.25 m of till to support vegetation. The cover for submerged tailings does not require the capillary break and therefore consists of 1-2 m of till. The main objectives for the cover were to “limit as practical, formation of efflorescent salts, potential for inhalation and intake of tailings dusts and salts, limit surface water infiltration into the tailings to not greater than the uncovered state, and reduce gamma and radon exposure to background levels” (Reference 1). To ensure these objectives are met over the life of the cover, CNSC and the Province of Saskatchewan ensure through licensing that SRC has developed quantifiable and measureable criteria for long-term monitoring.

SRC completed the cover remediation activities in 2015. SRC is currently entering a period of post-closure monitoring (Fall 2016) and surveillance intended to demonstrate that the site is behaving as predicted. SRC is also developing long-term monitoring and maintenance plans for the site that are required as part of licensing and environmental assessment follow-up.

3. Community Involvement

First Nations and Métis groups with interest in the project were identified in the early stages of the Lorado project by CNSC staff. Information used for preliminary identification of First Nations and Métis groups came from various sources such as:

- Aboriginal groups who have shown interest and/or have participated in other CNSC reviews within the area;
- Research on treaties and claims in the project area with support from Aboriginal Affairs and Northern Development Canada; and
- Information provided by the SRC with respect to their First Nation and Métis engagement activities (for this and previous projects in the area).

Thirteen First Nations and Métis groups were identified and encouraged to advise CNSC of any adverse impacts the project may have on any potential or established Aboriginal rights or opinions they may have in relation to the Lorado site. To date, CNSC has noted mainly positive feedback from communities regarding the Lorado remediation project. In one case, communities have requested that additional monitoring take place for dust, and SRC responded by continuing the air monitoring for an additional season. During the last CNSC inspection in 2015, SRC was hosting a representative from a First Nation group at the site who was there to observe activities, speak to workers and report back to his community on what he observed.

4. Regulatory Oversight

SRC was required to submit an application to support a review process under the *Nuclear Safety and Control Act* (NSCA) that led to the issuance of a licence to authorize SRC to manage the site and carry out remediation activities. In the case of Lorado, the objectives of remediation were defined in the licence application and the detailed design plans to meet those objectives were a requirement of the licence. Specific work plans, operational drawings, excavation limits and schedules associated with remediation were reviewed by CNSC and the Saskatchewan Ministry of Environment. These reports are considered licensing basis documents, making SRC obligated to implement the design for the tailings cover and remediation activities and to ensure that the processes accurately reflect the conditions as intended in these design documents. SRC is also required to submit annual compliance reports demonstrating that project activities are being done safely in accordance with licence requirements.

4.1 Compliance, Verification and Enforcement

CNSC staff conduct compliance activities in order to verify, enforce and report whether licensees are operating safely, securely, and in compliance with the requirements set out in the *Nuclear Safety and Control Act* (NSCA), its associated regulations, and licence conditions.

Under the *Nuclear Safety Control Act* (NSCA) and its associated regulations, various levels of regulatory action can be taken by CNSC to correct non-compliance by a licensee and to protect the health, safety and security of Canadians and the environment. When a non-compliance (or a continued non-compliance) has been identified, CNSC staff assess the significance of the non-compliance, and determine the appropriate enforcement action, based on CNSC's graduated approach to enforcement.

CNSC verifies compliance through regular site inspections and the review of operational activities and licensee documentation. We require licensees to report routine performance data and unusual occurrences. In addition, we conduct investigations of unplanned events or accidents involving nuclear materials or substances. We also collect samples and subsequently analyze them in our laboratory.

4.2 Inspection Methods

Inspection methods include visual observations, the review of records associated with licensed activities, interviews and discussions with onsite personnel, and the collection of independent verification samples of emissions or environmental media. Facts and findings collected during compliance activities are analyzed to identify non-compliances.

4.3 Reporting

CNSC regularly communicates the status of Canada's nuclear sector to Canadians through reports published on our web site, at public proceedings, and through outreach events with the general public, elected officials, Aboriginal groups and other key stakeholders.

4.4 Examples of Compliance Activities at Lorado

General site management prior to remediation

Prior to remediation, CNSC staff verified that SRC was carrying out the following maintenance and monitoring activities at the site: applying and maintaining a dust suppressant to eliminate the potential hazard of wind blown tailings; maintenance of a series of fences installed as a wind break; ensuring adequate signage; monitoring dust-fall, surface water and vegetation; and measurement of radiation along the public roadway that crosses the site. Staff reported that SRC was maintaining the site to an acceptable level of compliance, and that early feed back from the public was generally positive with respect to SRC's management of the site. In addition CNSC staff communicated regularly with staff from the Saskatchewan Ministry of Environment and reviewed all of the inspection reports prepared by SRC and the Province.

During this time CNSC staff conducted desktop reviews to verify that engineered designs adhered to change control processes and remained within the environmental assessment and safety envelope for the project.

Compliance during remediation

During construction and remediation activities, CNSC staff perform various compliance activities to verify that the project is proceeding according to accepted plans and procedures. Once construction and remediation activities are completed, CNSC staff verify that as-built drawings and the constructed facility both align with what was proposed during the licensing stage of the project. There is also an expectation that modifications in design or equipment will contribute to a continuous improvement in safety; changes should improve the safety case and not require additional Commission approvals so long as change control processes are followed and documented.

In 2015, part of the CNSC staff inspection focused on verifying the performance of the cover (Photo 2). Performance criteria were divided into three categories: technical performance criteria, containment performance criteria and environmental performance criteria (Reference 2). An example for each type of criteria at Lorado is provided below:

- Technical performance criteria specify that the cover should meet certain technical requirements including material properties such as density, thickness, and placement. The licensee had logged all data into a GPS computer software program that documents, compiles and displays all measurements along with a timeline of completion. CNSC staff were able to verify that the cover was being constructed according to specification for the

selected areas; this will support the eventual review of as-built records to verify technical specifications were met for the facility.

- Containment performance criteria specify that the cover should achieve a certain level of containment or control. The cover was designed to limit radiation to no higher than 2.5 micro Sievert per hour above background (spot reading) and no higher than 1.0 micro Sievert per hour above background as an average over 1 hectare. CNSC staff performed spot checks on the cover by measuring gamma radiation and found levels to be below the criteria in most cases levels were at or near background.
- Environmental performance criteria specify that environmental monitoring be adequate to measure concentrations of contaminants around the facility and that water quality criteria be met, with contaminant levels not exceeding a certain level, or predicted to decrease to a specific level. During all inspections, CNSC staff have observed environmental monitoring of surface water, air, and groundwater at the site. The results are provided in quarterly and annual reports by SRC. CNSC staff carry out regular desktop reviews of the information and ensure that SRC use the data to inform long-term monitoring plans for the site. Currently, CNSC staff are reviewing the long-term environmental monitoring program at Lorado to ensure enough monitoring data is available to demonstrate improving trends, and to verify that the engineered cover is performing as expected.



Photo 2: Cover on mine tailings at Lorado before final grading and seeding in 2015



Photo 3: Dust monitoring station at Lorado (2016)

In addition to verifying cover performance, CNSC staff verified that proper construction practices were followed for construction of the mine tailings cover, including quality control and assurance practices. This included the review of roles, responsibilities and competence of personnel, training of contractors and how changes to design are tracked and approved.

CNSC staff found that the licensee was safely managing the site and had established good practices including good quality control oversight for cover construction and employment of an independent environmental monitor to perform daily walks at the site and to observe all practices together.

5. Conclusion

This paper provides an example of CNSC compliance verification activities for a remediation project. In particular, dust suppression activities, the addition of lime to Nero Lake to control pH and contaminant mobility over the long term, and the performance of the engineered barriers are remediation elements that have been evaluated, and will continue to be monitored, by CNSC staff. The Lorado site underwent significant changes over several years owing to active remediation by the licensee – CNSC staff verified that remediation was effective, and that engineered and other interventions were performing as expected.

CNSC's licensing approach captures all project phases, from active remediation activities done to stabilize the site – to long term stability once active interventions are completed. This project lifecycle approach is necessary to ensure site safety as well as verifying the successful performance of the facility. Regulatory oversight of Lorado consists of yearly CNSC staff inspections at a minimum, desktop reviews of quarterly and annual reports from SRC, and the review of as-built reports. The successful collaboration between regulatory bodies and the licensee and has led to significant improvements of the site.

References

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